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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL DIRECTORATE OF GEOGRAPHY AND CADASTRE (DINAGECA)

THE NATIONAL TOPOGRAPHIC MAPPING IN MANHIÇA PROVINCE IN THE REPUBLIC OF MOZAMBIQUE

TOPOGRAPHIC MAP REVISION

MANHIÇA

JULY 2000

KOKUSAI KOGYO CO., LTD.

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
NATIONAL DIRECTORATE OF GEOGRAPHY AND CADASTRE (DINAGECA)

THE NATIONAL TOPOGRAPHIC MAPPING IN NIASSA PROVINCE IN THE REPUBLIC OF MOZAMBIQUE

TOPOGRAPHIC MAP REVISION MANUAL

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TOPOGRAPHIC MAP REVISION MANUAL

- DIGITIZING EXISTING MAP MANUAL
- REVISION OF DIGITAL MAPS MANUAL
- ORIENTATION USING THE DiAP DIGITAL PLOTTER MANUAL V1.03
- DIGITAL PLOTTER UTILITY DiAP Dynamic Menus (DiAP DDM) MANUAL 2nd Edition
- DIGITAL MAP EDITOR MicroStation MANUAL
- DIGITAL PLOTTER UTILITY DiAP AERIAL TRIANGULATION MODULE (DiAP ATM) MANUAL
- SCANNING OF MAP SHEETS MANUAL
- SCANNING OF AERIAL PHOTOS MANUAL

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DIGITIZING EXISTING MAPS MANUAL

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1. Objective of Work Planning

The formulation of a work plan is an important part of digitizing existing maps. It is essential to understand how to use this manual as it clarifies the objective of work planning.

1.1 Objective of Work Planning

The objective of work planning is to maintain work quality and to a smoothly carry out works through a full understanding of the whole process of digitizing existing maps.

1.2 How to Use This Manual

This manual has been prepared to allow smooth work planning of the digitizing of existing maps and to unify the operations.

Work planning follows the order of this manual. Refer to it in case of problem during this work. If a problem or its solution are not mentioned in this manual, the user is invited to add a memo on the subject in the appendix.

2. Outline of Work Planning

Work planning entails collecting and studying needed information, and then formulating a work plan.

2.1 Collection of Needed Information

Collect the following information which are necessary for the formulation of the work plan.

- Work area and its size
- Applicable work methods
- Available equipment
- Human resources
- Work period
- Others (scale and quality of existing maps, items to be digitized, etc.)

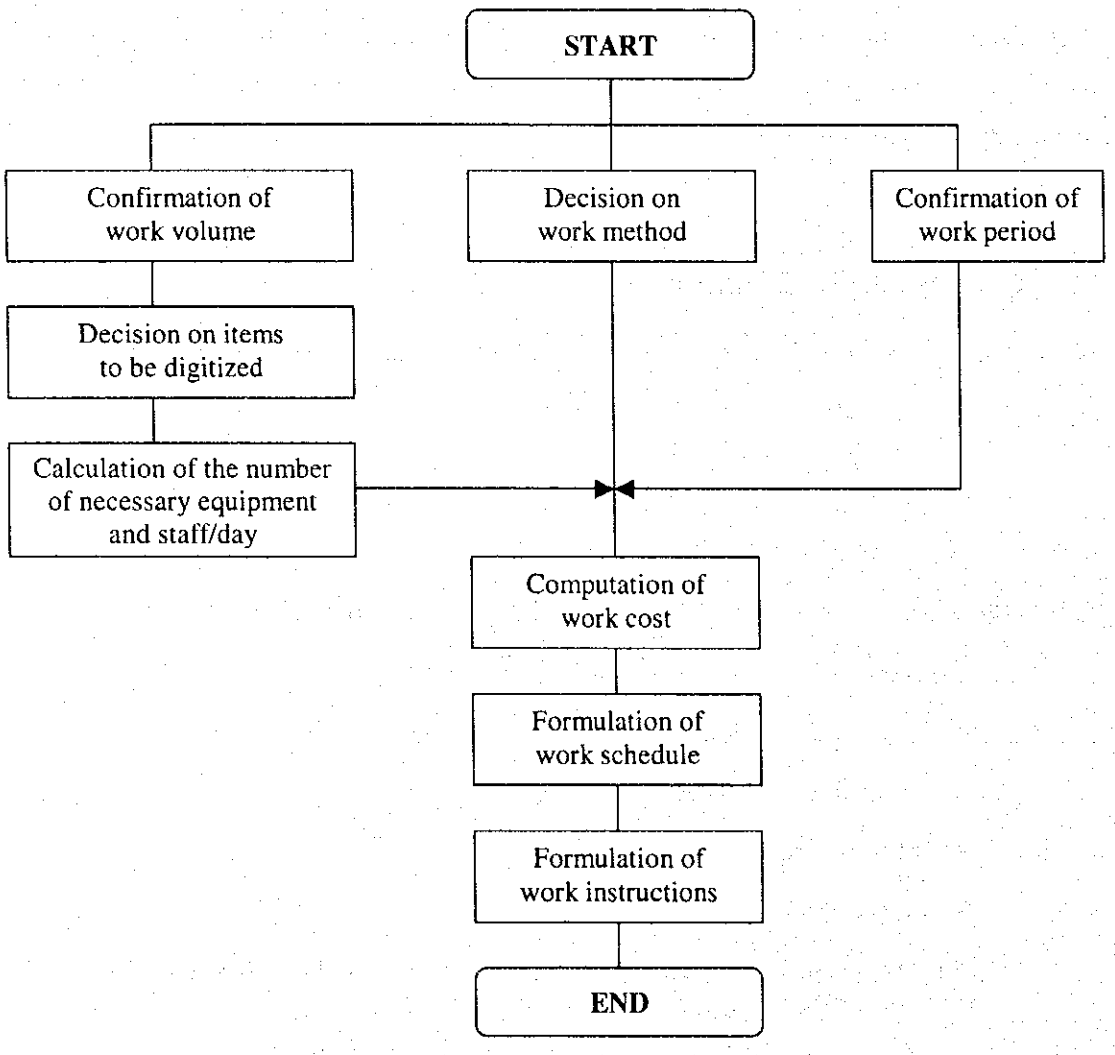
2.2 Outline of Work Planning

Prepare the work plan based on the information collected in 2.1. The plan will include the following items:

- Work method
- Equipment to be used
- Work progress
- Staff mobilization plan
- Formulation of work instructions

3. Formulation of a Work Plan

3.1 Flowchart of Work Plan Formulation



3.2 Confirmation of Work Volume, Decision on Work Method, Confirmation of Work Period

3.2.1 Confirmation of Work Volume

Confirm the existing map digitizing work volume. Determine the following items, which will be used for the subsequent planning work:

- Scale of existing maps to be digitized
- Number of sheets to be digitized
- Area to be digitized

3.2.2 Decision on Work Method

There are currently 2 main methods to digitize existing maps:

① Digitizing

② Scanning

Decide on the digitizing work method based on the type and quantity of equipment available. This decision must take into account the order of subsequent work, the work period, etc.

3.2.3 Confirmation of Work Period

Determine the date for the beginning of the work and the work period.

3.3 Decision on Items to be Digitized

Decide whether you will digitize all the features shown on the map to be digitized or only a number of selected items.

To decided what items to digitize, refer to the map symbol items of 1:50,000-scale digital topographic maps.

3.4 Calculation of The Number of Necessary Equipment And Staff/Day

Determine the quantity of equipment and the number of staff per day required for the completion of each step based on the confirmation of work volume and decision on work method. This computation will take into account the standard work volume (per equipment or per person) based on statistic documents of past similar work. In case few existing maps have

been digitized in the past, estimate the standard work volume. However, make sure to keep a record of work volume implemented in the course of this work in order to make statistic documents which can be used for subsequent similar work.

3.5 Computation of Work Cost

Calculate the cost of the work based on the "quantity of necessary equipment" and the "number of necessary staff/day for each step" as determined in 3.4, taking the following into account:

- Depreciation cost per day per necessary equipment
- Personnel expenses per day (taking into account each technician's rank)
- Personnel expenses for quality control

3.6 Formulation of Work Schedule

Formulate the work schedule based on the "quantity of necessary equipment" and the "number of necessary staff/day for each step" as determined in 3.4, taking into account the number of equipment and staff that can be mobilized.

3.7 Formulation of Work Instructions

Write down instructions for each work process based on the work schedule formulated in 3.6. These instructions will be prepared in accordance with the technical specifications (work specifications on digital topographic map revision), and will call attention to special considerations. They will also fix the quality control process.

4. Distribution of the Work Plan

Distribute the work schedule and the work instructions produced in "3. Formulation of a Work Plan" within the related department.

5. Objectives of the Production of Base Maps for Digitizing

Many problems may arise if digitizing is carried out on original copies of existing maps. It is, therefore, necessary to produce map sheets for digitizing instead of using the original copies.

5.1 Objectives of the Production of Base Maps for Digitizing

Digitizing operations are based on existing maps which are made of polyester or paper, but for various reasons, original map are sometimes unsuitable for digitizing. Consequently, documents to be digitized, i.e. base maps for measurement, must be made using the original sheets of these maps. The objective of the production of base maps for measurement, therefore, is to reproduce existing maps for digitizing.

5.2 How to Use This Manual

This manual has been prepared to clarify the process of making base maps for measurement and to allow smooth operations.

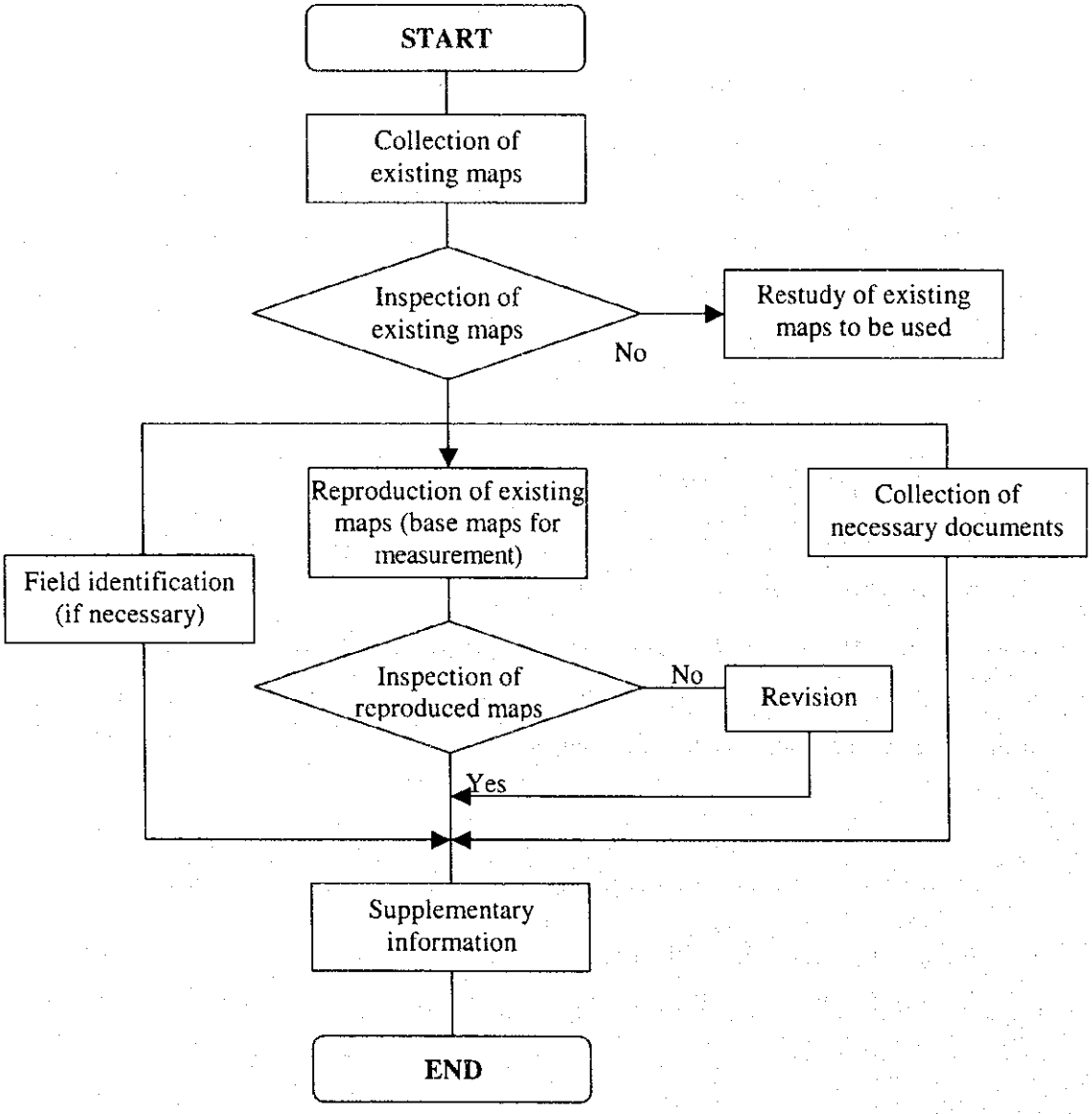
The production of base maps for measurement follows the order of this manual. Refer to it in case of problem during this work. If a problem or its solution are not mentioned in this manual, the user is invited to add a memo on the subject in the appendix.

6. Outline of the Production of Base Maps for Digitizing

The production of base maps for measurement comprise the collection of existing maps for digitization and reproduction. These reproductions shall be the base maps for measurement.

7. Production of Base Maps for Digitizing

7.1 Flowchart of the Production of Base Maps for Digitizing



7.2 Collection/Inspection of Existing Maps

7.2.1 Collection of Existing Maps

The map sheet showing the target area for digitization or the target map sheet shall be collected as specified in the work plan. In principle, original maps shall be collected.

7.2.2 Inspection of Existing Maps

The collected map sheets shall be inspected with regard to shrinkage, dirt, and contents.

- Shrinkage

  The map sheet borderline and grid lines of the collected sheets shall be measured to determine whether shrinkage is within the permissible limit. In case it exceeds the limit and the sheets are not usable, the use of these existing maps must be reconsidered.

- Dirt

  Before making reproductions, the existing maps shall be inspected for dirt and cleaned if necessary.

- Inspection of Contents

  The production and revision dates of the collected existing maps shall be inspected in order to determine secular changes that could have occurred. If needed, field identification shall be carried out to collect additional information as well.

7.3 Field Identification/Collection of Necessary Documents

Based on the results of the inspection of the contents of the existing map and if deemed necessary, field identification and collection of necessary documents shall be carried out.

7.3.1 Field Identification

Based on the results of the inspection of existing maps, field identification should be carried out if deemed necessary. The field identification results will be reflected in the base maps for measurement, reproduced from the existing maps.

7.3.2 Collection of Necessary Documents

Based on the results of the inspection of existing maps, relevant documents shall be collected to obtain necessary information.

7.4 Reproduction of Existing Maps

The material to be used to reproduce existing maps must be polyester film, with low expansion/shrinkage, or another material of similar quality.

7.4.1 Reproduction

Existing maps shall be reproduced for every type of feature to digitize (roads, buildings, contours, etc.). However, the sheets may be combined as long as it does not hinder subsequent measurement work.

7.4.2 Inspection of Reproduced Maps

The reproduced maps (base maps for measurement) shall be inspected by comparing them with the original existing maps, to insure that there will be no hindrances to the subsequent work. Revisions shall be carried out if necessary.

8. Supplementary Information

After the inspections and revisions, supplementary information will be added to the base maps for measurement based on the results of 7.3.1, *Field Identification,* and 7.3.2, *Collection of Necessary Documents,* if necessary.

Supplementary information shall be added using drawing pens so as not to hamper subsequent measurement work.

9. Digitizing Objectives

When digitizing necessary topographic data using the base maps for digitizing (analog sheets), a scanner or a digitizer is used.

9.1 Digitizing Objectives

The base maps for digitizing are analog sheets. Digitizing comprise digitizing these analog information using a scanner or a digitizer. When digitizing, the data may either be in a vector or raster format.

9.2 How to Use this Manual

This manual has been prepared to clarify the digitizing process involved in digitizing topographic maps using base maps for digitizing, and to allow smooth operations.

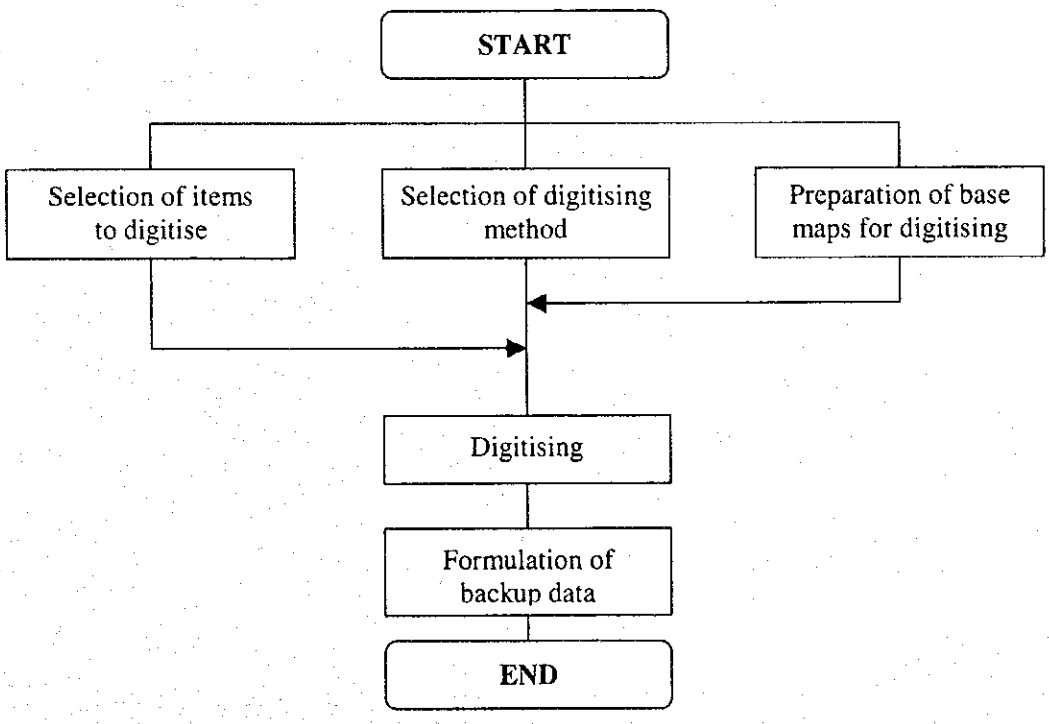
Digitizing operations shall be carried out as indicated in this manual. This manual should be referred to in case any problem arises during the course of the operations. Problems and solutions thereof not mentioned in this manual, as well as new processes learnt during the conduct of the operations, may be incorporated as an addendum.

10. Outline of Digitizing

Digitizing comprise digitizing existing maps using a scanner or a digitizer, based on base maps for digitizing. In case a scanner is used, the data should be converted to vector format from the raster data, if necessary. Classification codes shall be allocated during digitizing and the conversion of the data to vector format from the raster.

11. Digitizing

11.1 Digitizing Flowchart



11.2 Preparation for Digitizing

11.2.1 Preparation of Base Maps for Digitizing

Base maps for digitizing are necessary to digitize existing maps and should be prepared therefore.

11.2.2 Selection of Digitizing Method

The method of measurement, i.e. use of scanner or digitizer, shall be determined after examining available equipment, digitizing objectives, work volume and the time period available.

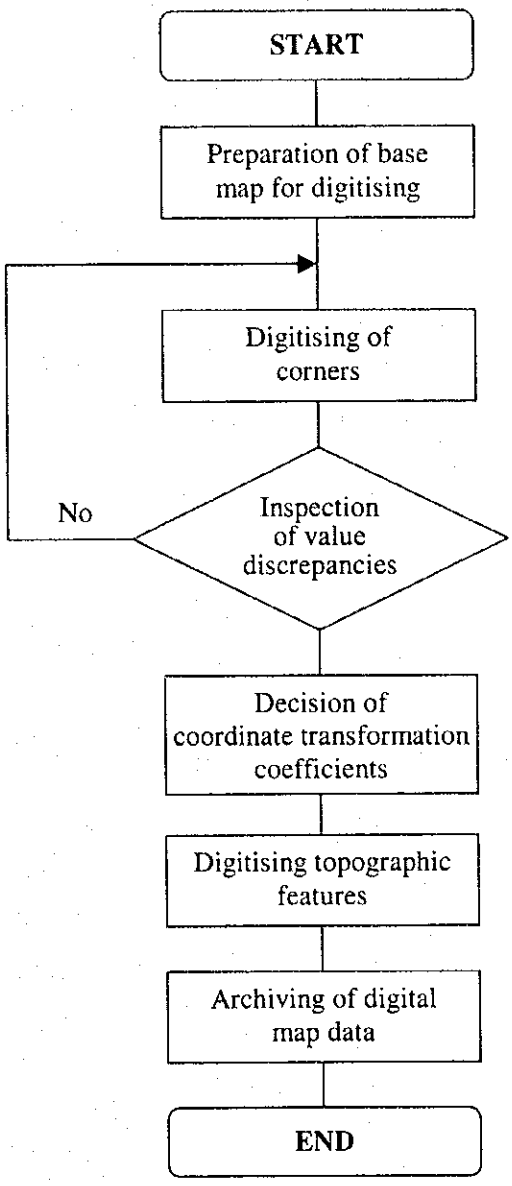
11.2.3 Selection of Items to Digitize

The items to digitize shall be selected in accordance with the digital map symbol regulations and the graphics and feature codes, with due consideration of the digitizing objectives.

The digitized items should be recorded in a document format.

11.3 Digitizing (Digitizer)

11.3.1 Detailed Flowchart of Digitizing (Digitizer)



11.3.2 Digitizing

a) Preparation of base map for digitizing

Place the base maps for digitizing on the digitizer and prepare the digitizing menu.

b) Digitizing of corners

Start the digitizer and measure the 4 corners of the base map for measurement twice.

c) Inspection of corner value discrepancies

Check whether the discrepancy between the values measured in b) is within the permissible limit (0.3mm).

d) Decision of coordinate transformation coefficients

Determine which coefficient to use for coordinate transformation (Helmert transformation, Affine transformation) in order to transform the machine coordinate values of the corners into UTM coordinate values.

e) Digitizing topographic features

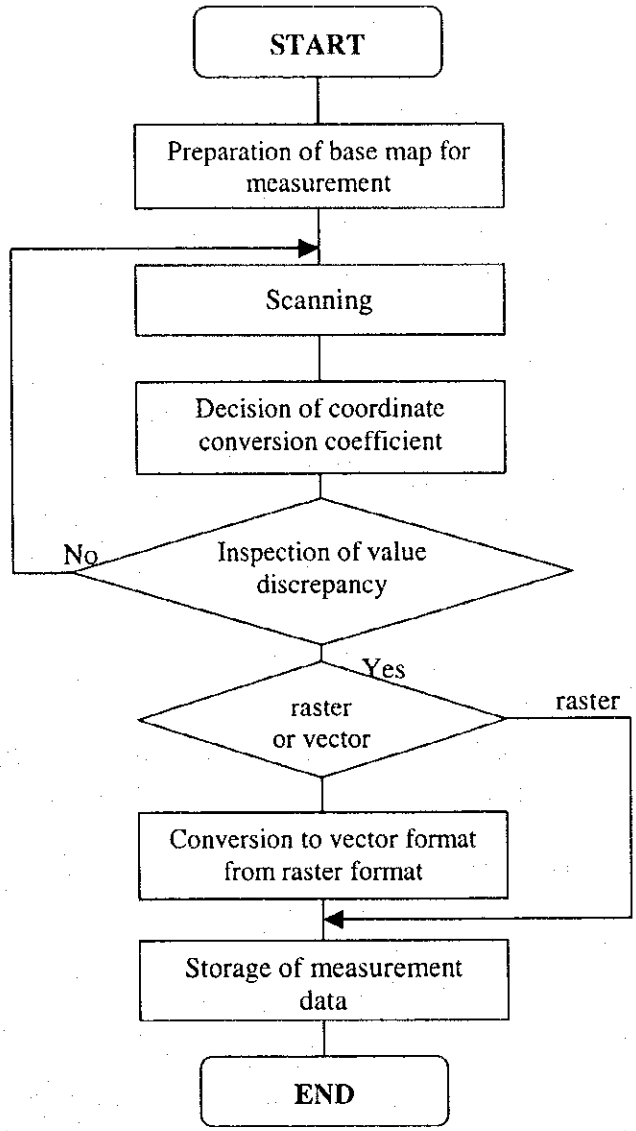
Digitizing shall be carried out by using code to classify topographic features

f) Archiving of digital map data

The digital map data shall be stored in sheets. The data file shall be named in accordance with specified regulations.

11.4 Digitizing (Scanner)

11.4.1 Detailed Flowchart of Digitizing (Scanner)



11.4.2 Digitizing

a) Preparation of base map for measurement

The base map for measurement shall be prepared and free of dust and other materials that may generate noise.

b) Scanning

Scanning shall be carried out by setting the specified scanning density. Refer to the separate manual for the use of a scanner.

c) Decision of coordinate transformation coefficients

When transforming the scanner coordinates to UTM, the corner raster data shall

be used to decide the coordinate transformation coefficient format.

d) Selection of data format

The data format (raster or vector) shall be selected as deemed necessary.

e) Conversion to vector format from raster format.

When the vector format is required, data should be converted from the raster format to the vector format. Refer to the separate manual for the details of the conversion.

f) Storage of measurement data

Measurement data shall be stored in sheets. The data file name shall be in accordance with the specified regulations.

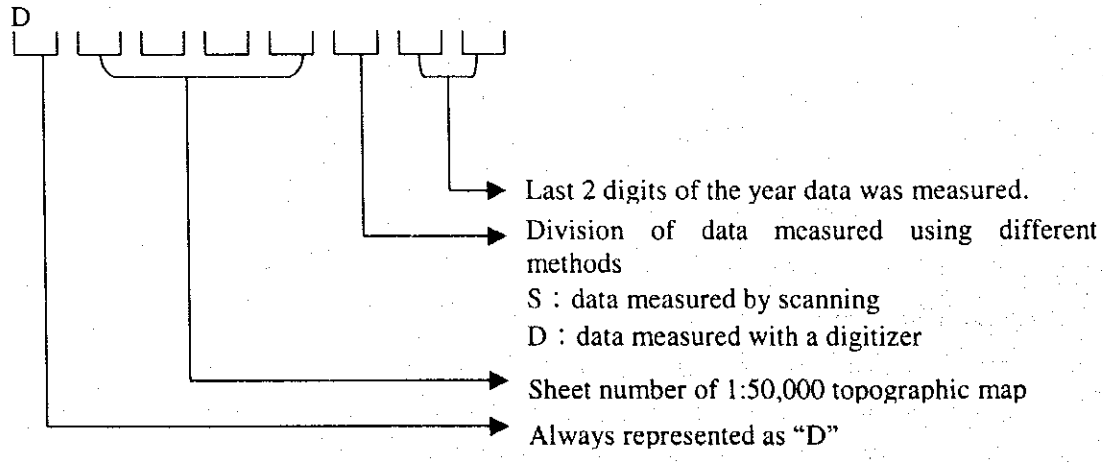
12. Storage of Measurement Data

The data file name for measured data shall be as specified and a backup data shall be made.

12.1 File Names

Name the files homogeneously in accordance with the scale level, based on the file naming standards for the whole country.

· For 1:50,000 topographic maps



Ex.

D1125S99 : 1:50,000 topographic map number 1125; file name for data measured by scanning in 1999

D0101D00 : 1:50,000 topographic map number 101; file name for data measured with a digitizer in 2000

12.2 Backup

In accordance with section 12.1, File Names, digital map data should be given a file name, provided with a backup, and stored. The backup shall be created as specified in a separate manual.

13. Objectives of Editing and DM Data File Creation

It is not possible to use raw digitizing data as it is for subsequent work. Data has to be freed of any noise and converted to a standard format prior to use.

13.1 Editing Objectives

It is not possible to use raw measured data as it is for subsequent work. Editing shall also comprise any necessary revision to make the data usable in subsequent work.

13.2 Objectives for the DM Data File Creation

Digitizing data that has been compiled should be stored for future use. The DM data file creation shall comprise to be named and stored a compiled DM data.

13.3 How to Use this Manual

This manual has been prepared to clarify the processes involved in the creation of a DM data file and to allow the works to be carried out smoothly.

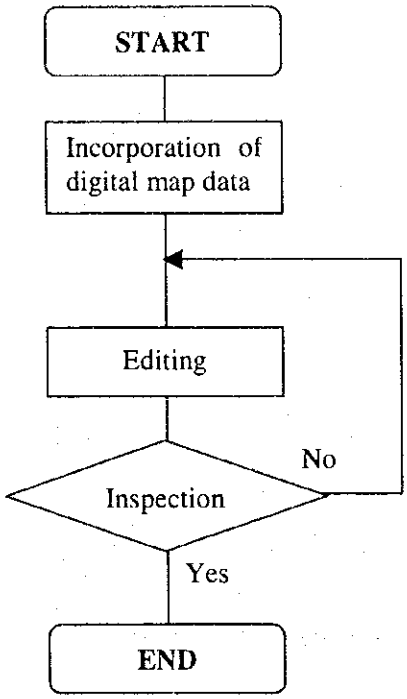
Editing and DM data file creation shall be carried out as indicated in this manual. This manual shall be referred to in case any problem arises in the conduct of the work. Problems and solutions thereof not mentioned in this manual, as well as new processes learnt during the conduct of the operations, may be incorporated as addenda.

14. Editing Outline

Editing shall be carried out using a computer, graphics display, tablets, etc., to delete, revise or add data, for the creation of compiled data.

15. Editing

15.1 Editing Flowchart



15.2 Editing

15.2.1 Incorporation of data measured

The digital map data shall be placed on the editing work station. The processes involved in data editing are as specified in a separate manual.

15.2.2 Editing

Editing comprise the removal of noise, additions of deficient sections, deletion and revision in the digital map data. Each data shall be allocated with attribute information e.g. feature code. The processes involved are as detailed in a separate manual.

15.3 Inspection

Edited data shall be inspected for errors. Inspection shall be carried out using output maps and the graphic display.

15.3.1 Production of Output Maps for Inspection

The output maps to be produced for inspection shall contain the map sheet number, map name, map sheet borderlines, gridlines, map symbols and attributes. The items on the output map shall be decided after studying the details of the inspection work.

The output map production method shall be as indicated in the separate manual.

15.3.2 Inspection Using Output Maps

The items to be inspected on the output map are as follows:

① Items to be digitized

② Accuracy of the location of the item to be digitized

③ Adjoining of adjacent map sheets

Inspection of items ① and ② shall be carried out by superimposing the output map for inspection over the base map for measurement. The results of inspection shall be indicated on the output and used for revisions.

The printouts of adjacent map sheets will both be used for the inspection.

15.3.3 Inspection by Graphic Display

The items to be inspected by graphic display shall be the same as the items to be inspected using output maps (15.3.2).

The inspection of each item shall be carried out by displaying simultaneous the digital map data and the raster data on screen.

15.3.4 Revision for Inspection

Errors detected during the inspection of the data using the output map and the display shall be revised by the same method for editing using the base map for measurement in the revised editing.

The joining of adjacent map data shall not only be in accordance with the design but shall also be carried out digitally.

16. Outline of DM Data File Creation

The creation of the DM data file comprises attributing designated file names to edited data, addition of relevant information on necessary data, and the storage of the data in an electronic medium.

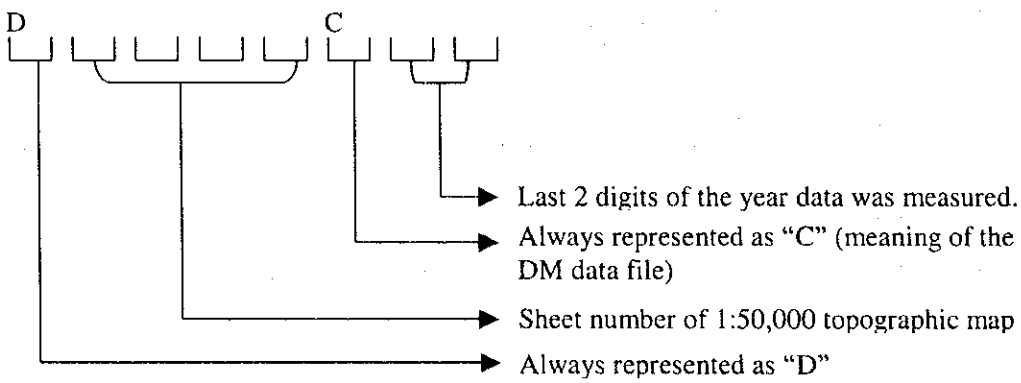
17. DM Data File Creation

Data that has been edited or undergone revised editing shall be considered as DM data, attributed a designated file name and stored in an electronic medium.

17.1 DM Data File Name

Name the files homogeneously in accordance with the scale level, based on the file naming standards for the whole country.

• For 1:50,000 topographic maps



Ex.

D1013C99 : 1:50,000 scale topographic map number 1013; DM data file produced in 1999

D0051C02 : 1:50,000 scale topographic map number 51; DM data file produced in 2002

REVISION OF DIGITAL MAPS MANUAL

JULY 2000

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JICA STUDY TEAM

CONTENTS

1. Objective of Work Planning

The formulation of a work plan is an important part of revising digital topographic maps. It is important to understand how to use this manual as it clarifies the objective of work planning.

1.1 Objective of Work Planning

The objective of work planning is to maintain work quality and to smoothly carry out works through a full understanding of the whole digital map revision operations.

1.2 How to Use This Manual

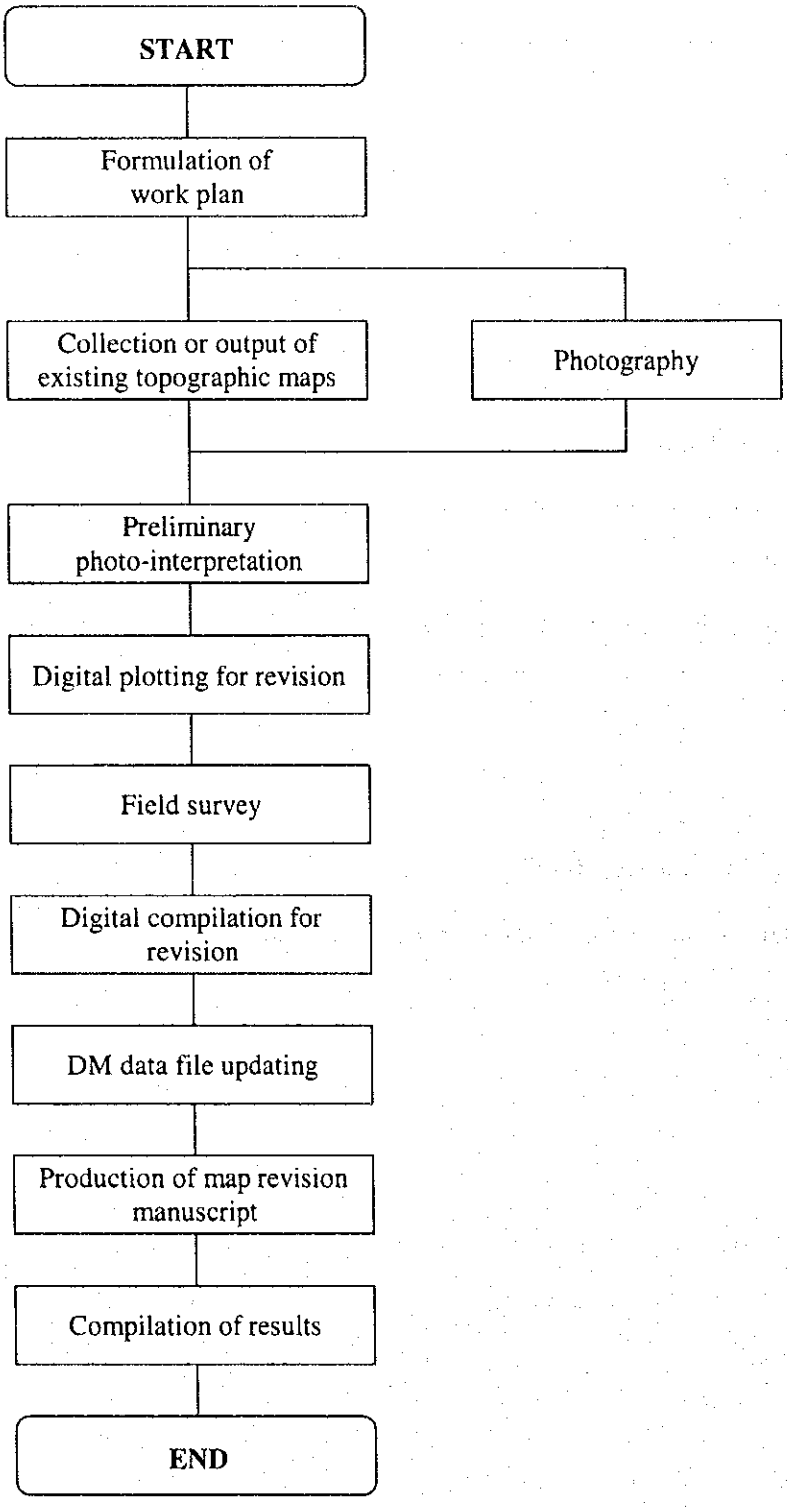
This manual has been prepared to allow smooth work planning of digital map revisions and to unify the operations.

Work planning follows the order of this manual. Refer to it in case of problem during this work. If a problem or its solution are not mentioned in this manual, the user is invited to add a memo on the subject in the appendix.

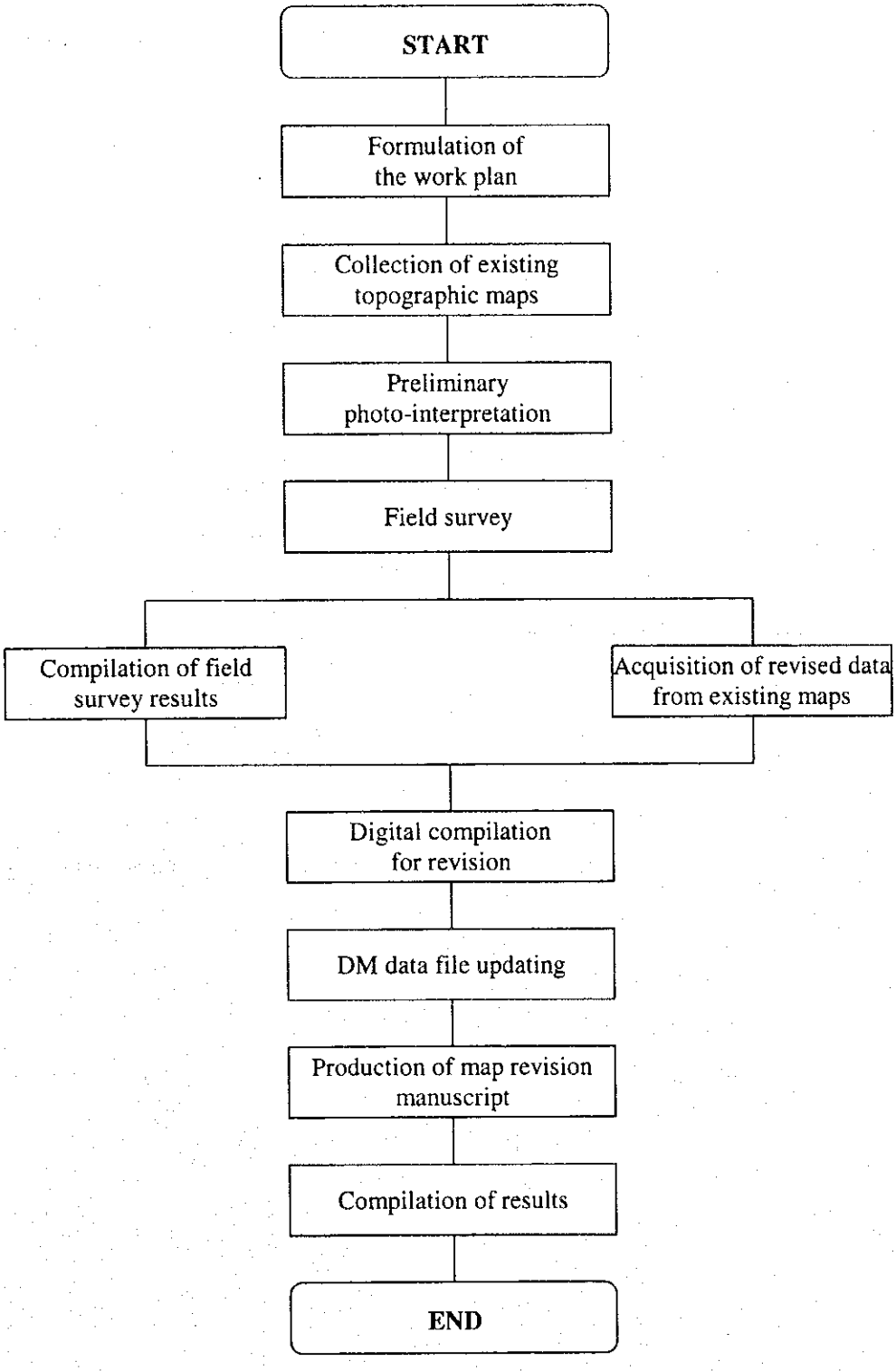
1.3 Outline of Digital Map Revision

In principal, digital map revision work is carried out in the following order. (However, this manual only covers the method using aerial photos.)

1.3.1 Flowchart of Digital Map Revision Using Aerial Photos



1.3.2 Flowchart of Digital Map Revision Using Existing Maps



2. Outline of Work Planning

Work planning comprises collecting and studying needed information, and then formulating a work plan.

Note: This manual only covers the revision of digital topographic maps using aerial photos.

2.1 Collection of Needed Information

Collect the following information which are necessary for the formulation of the work plan.

- Work area and its size
- All existing data
  Necessary existing data include aerial photos of the study area taken previously (with all attribute information such as date of photography) and information on secular changes.
- Human and material resources
- Work period

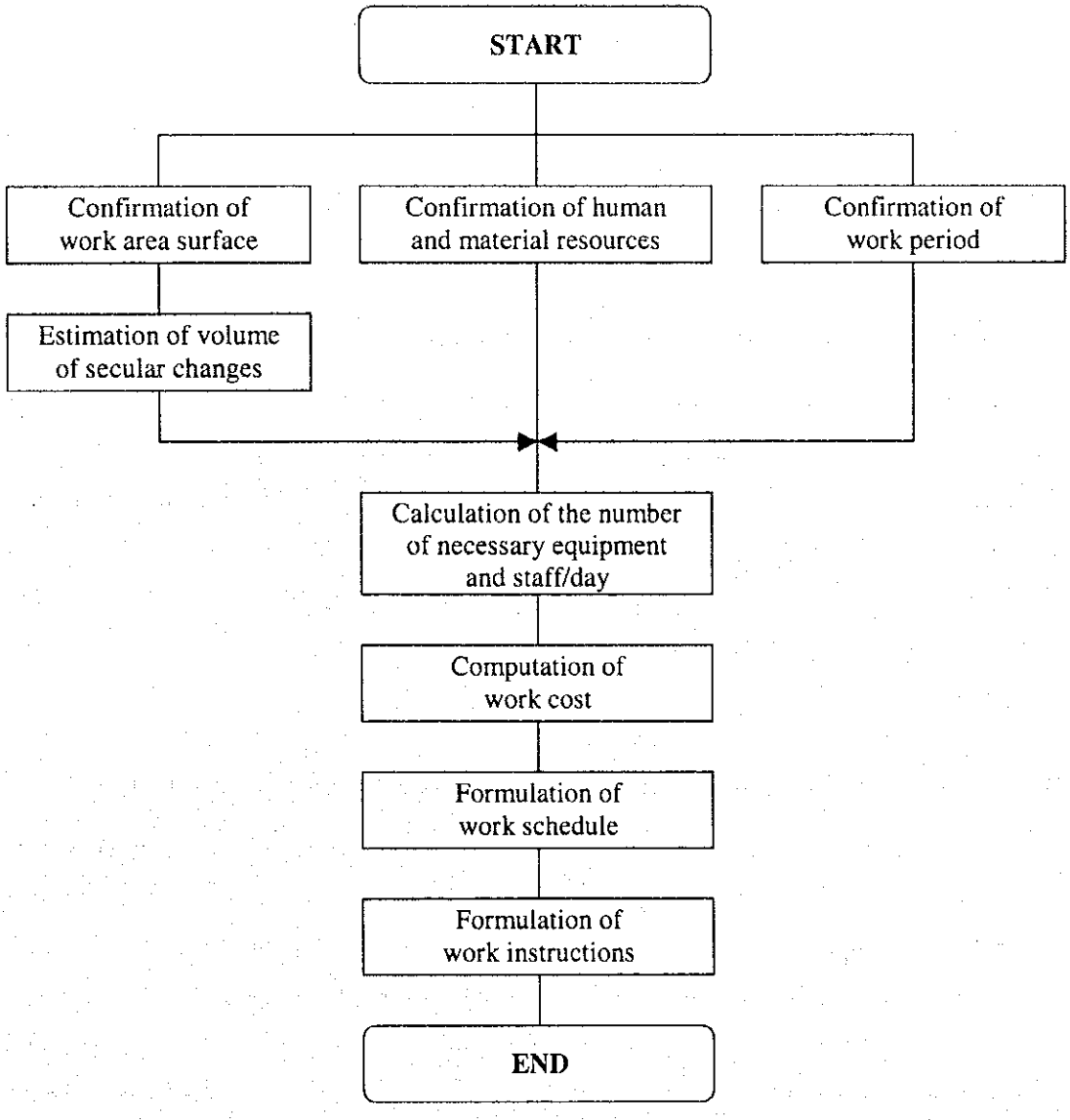
2.2 Outline of Work Planning

Prepare the work plan based on the information collected in 2.1. The plan will include the following items:

- Schedule
- Staff mobilization plan
- Formulation of instructions

3. Formulation of a Work Plan

3.1 Flowchart of Work Plan Formulation



3.2 Confirmation of Work Area Surface

Confirm the work area for the revision of topographic maps and the following items must be known:

- The work area
- Items which must be digitized
- Topography

This information will be used for the subsequent planning work.

3.3 Confirmation of Human And Material Resources

Confirm the human resources and the quantity of equipment that are currently available. Determine the period which can be allotted to the work. This information will be used for the subsequent planning work.

3.4 Confirmation of Work Period

Confirm the date for the beginning of the work and the work period.

3.5 Estimation of Volume of Secular Changes

The volume of secular changes is an important factor in formulating the work schedule. However, at the work planning stage, the preliminary photo-interpretation has not been conducted yet and it is impossible to determine the exact volume of changes. Consequently, the volume of secular changes is estimated based on the collected data and documents. This work plan formulated from estimations will then be revised based on the volume of changes determined after the preliminary photo-interpretation work.

3.6 Calculation of The Number of Necessary Equipment And Staff/Day

Determine the quantity of equipment and the number of staff per day required for the completion of the work for each process, based on the work area and the volume of secular changes. This computation will take into account the standard work volume (per equipment or per person) based on statistic documents of past similar work. In case few digital map revisions have been implemented in the past, estimate the standard work volume. However, make sure to keep a record of work volume implemented in the course of this work in order to make statistic documents which can be used for subsequent similar work.

3.7 Computation of Work Cost

Calculate the cost of the work based on the "quantity of necessary equipment" and the "number of necessary staff/day for each step" as determined in 3.6. When computing the cost of the work, the following must be taken into account:

- Depreciation cost per day per necessary equipment
- Personnel expenses per day (taking into account each technician's rank)

- Personnel expenses for quality control

3.8 Formulation of Work Schedule

Formulate the work schedule based on the "quantity of necessary equipment" and the "number of necessary staff/day for each step" as determined in 3.6, taking into account the number of equipment and staff that can be mobilized.

3.9 Formulation of Work Instructions

Write down instructions for each work process based on the work schedule formulated in 3.8. These instructions will be prepared in accordance with the technical specifications (work specifications on digital topographic map revision), and will call attention to special considerations. They will also fix the quality control process.

4. Distribution of the Work Plan

Distribute the work schedule and the work instructions produced in "3. Formulation of a Work Plan" within the related department.

5. Objective of Preliminary Photo-Interpretation

5.1 Objective of Preliminary Photo-Interpretation

When revising digital maps, it is important to identify the areas which have changed with time, and which will thus be revised. Preliminary photo-interpretation entails identifying the places of secular changes, using the latest aerial photos and other relevant documents. It also comprises inspecting the areas which were not affected by secular changes.

5.2 How to Use This Manual

This manual has been prepared to allow smooth preliminary photo-interpretation for digital map revisions and to unify the operations.

Preliminary photo-interpretation follows the order of this manual. Refer to it in case of problem during this work. If a problem or its solution are not mentioned in this manual, the user is

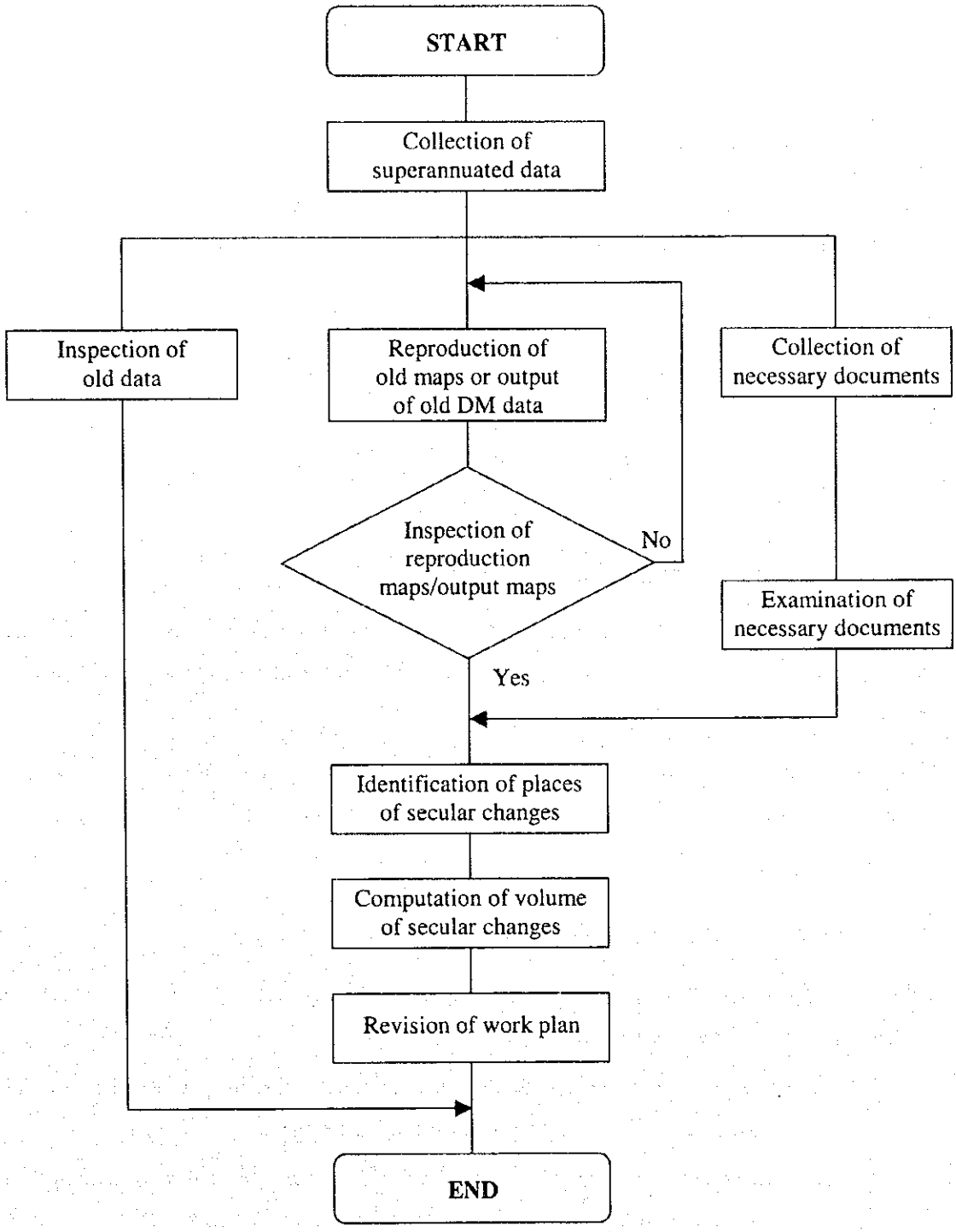
invited to add a memo on the subject in the appendix.

6. Outline of Preliminary Photo-Interpretation

During preliminary photo-interpretation, you will inspect superannuated data (old maps or old DM data) and identify the places which were affected by secular changes using reproductions of old maps, output maps of old DM data files, the latest aerial photos and other relevant documents, in order to define the volume of changes. You will also revise the work plan based on these results.

7. Preliminary Photo-Interpretation

7.1 Flowchart of Preliminary Photo-Interpretation



7.2 Collection of Superannuated Data

Collect all the relevant data on the areas of the digital topographic maps to be revised. These data will consist of the following items:

- Old manuscript maps related to the work area or old DM data files

7.3 Inspection of Superannuated Data

Inspect the content of the collected superannuated data. Concerning old DM data files, pay special attention to the following items:

- File structure
- Data file format
- Quality of the data
- Logical consistency of the data

7.4 Reproduction of Old Maps or Output of Old DM Data

Prepare reproductions of old maps from collected superannuated data, or output maps from old DM data files at the same scale as the new DM data, which will be used as map sheets for preliminary photo-interpretation.

Inspect the content of the reproduction maps or the output maps. The items to be inspected will be the quality of lines such as the map sheet borderlines and gridlines.

7.5 Collection of Necessary Documents

Collect the documents related to the work area, which will be necessary for the revision of digital maps. The necessary documents are as follows:

- The most recent aerial photos (including not only the photos taken for this digital map revision project but also for other projects)
- Documents on control points (information on the latest distribution of triangulation points and bench marks)
- Documents on geographical names and boundaries (data on the changes in geographical names and administrative boundaries due to administrative reforms)

- Other documents (data on secular changes in topography and features)

Examine the collected documents to find out whether they can be used for the revision of digital maps. Organize the usable documents in a form that facilitates their use.

7.6 Identification of Places of Secular Changes

7.6.1 Preparation of Reproduction Maps or Output Maps

Prepare the reproduction maps or output maps showing the results of preliminary photo-interpretation. (The media for these maps should be paper.)

7.6.2 Preparation of Aerial Photos

Print the aerial photos by sheet units roughly at the same scale as the map sheets. Draw the map sheet borderlines on each aerial photo using a pencil for photos.

7.6.3 Identification of Places of Secular Changes

Identify the places of secular changes by comparing the map sheets and the aerial photos. Clearly mark the areas of secular changes identified, both on the map sheets and on the aerial photos. (Use a color pencil on the map sheets, and a pencil for photos on the aerial photos.)

Concerning control points, compare the documents collected in 3.5 and the map sheets, and mark the items of secular changes on the map sheets.

Concerning geographical names and boundaries, compare the documents collected in 3.5 and the map sheets, and mark the items of secular changes on the map sheets.

The map sheets showing the places of secular changes will be referred to as "preliminary photo-interpretation maps" from here on.

7.7 Computation of Volume of Secular Changes

Compute by sheet units the areas of secular changes shown on the preliminary photo-interpretation maps.

7.8 Revision of Work Plan

The work plan was formulated previously based on an estimation of the volume of secular changes. As an accurate volume of secular changes has been determined as a results of preliminary photo-interpretation, re-examine the whole work plan and formulate a new plan based on the accurate values.

8. Objective of Digital Plotting for Revision

8.1 Objective Of Digital Plotting For Revision

Digital plotting for revision entails the creation of digital plotting data for secular changes identified based on the results of the preliminary photo-interpretation work.

8.2 How To Use This Manual

This manual has been prepared to allow smooth digital plotting operations for revision and to maintain homogeneity. Concerning how to start the digital plotter and its operation, please refer to the manual provided separately.

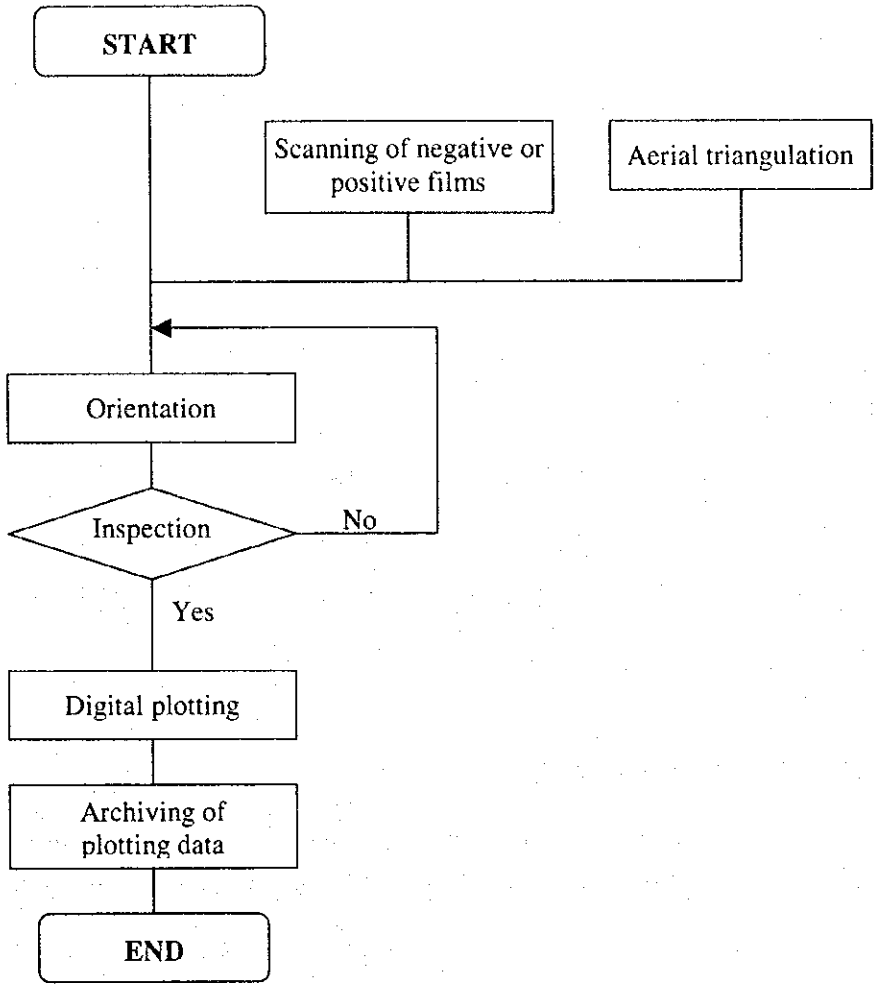
Digital plotting for revision follows the order of this manual. Refer to it in case of problem during this work. If a problem or its solution are not mentioned in this manual, the user is invited to add a memo on the subject in the appendix.

9. Outline of Digital Plotting for Revision

The map data will be acquired by conducting digital plotting of the secular changes using the newly taken aerial photos, the preliminary maps and the results of aerial triangulation. The designated map symbol codes will be allotted to the corresponding map data.

10. Digital Plotting for Revision

10.1 Flowchart of Digital Plotting for Revision



10.2 Scanning of Negative or Positive Films

The aerial photos used for the preliminary photo-interpretation work will be scanned to prepare for digital plotting.

10.2.1 Scanning

If the aerial photos used for preliminary photo-interpretation have already been subjected to aerial triangulation, scan the positive films. In case they have not been subjected to aerial triangulation, scan either the negative films or the positive films.

For the operation of the scanner used for film scanning, please refer to the manual provided

separately.

The limit for film scanning accuracy is 15μm.

10.3 Aerial Triangulation

When applying aerial triangulation to the aerial photos used for preliminary photo-interpretation, use the bundle method.

Concerning planning and preparation for aerial triangulation, point selection, (point transfer,) observations and adjustment computations, please refer to the manual provided separately.

10.4 Orientation

10.4.1 Orientation Using the Results of Aerial Triangulation

Use the results of aerial triangulation, if it has already been completed, to conduct relative and absolute orientation. Concerning orientation using the results of aerial triangulation on the digital plotter, please refer to the manual provided separately.

10.4.2 Other Orientation

In case aerial triangulation has not been carried out, chose 6 tie points and conduct relative orientation analytically. For absolute orientation, use the coordinate values of the DM data files.

Concerning other orientation on the digital plotter, please refer to the manual provided separately.

10.4.3 Inspection of Orientation

The orientation results must be inspected, whether the method explained in 10.4.1 or 10.4.2 has been adopted. The results to be inspected are the residual Y-parallax obtained with relative orientation, and the tie point residual errors obtained with absolute orientation.

In case the residual errors exceed the limit, find out the cause and conduct orientation again.

10.5 Digital Plotting

When orientation and inspection have been completed, proceed to digital plotting. Concerning the method to start the digital plotter and its operation, please refer to the manual provided separately.

10.5.1 Order of Digital Plotting

In principle, digital plotting will be conducted in the following order: line features, buildings, vegetation, photo control points and contours.

10.5.2 Classification Codes

In order to tabulate all the features by category, allocate the feature codes defined in the map symbol specifications to the topographic data acquired by digital plotting.

10.5.3 Acquisition of Topographic Data (Contour lines)

Concerning the contour data acquisition interval, the standard is a distance interval of 1mm (on the map). However, it may vary according to the topographic conditions.

10.5.4 Ambiguous Areas of Digital Plotting

All the areas for which photo-interpretation and digital plotting are hindered by obstacles such as clouds or halation will be clearly marked on the plotting output map and acquired by field identification.

10.5.5 Inspection of Digital Plotting Data

When digital plotting is completed, print an output map for inspection using the obtained data. The output map scale must be the same as the map being revised.

Inspect the output map by comparing it with the aerial photos and the collected data in order to detect any plotting omission or error.

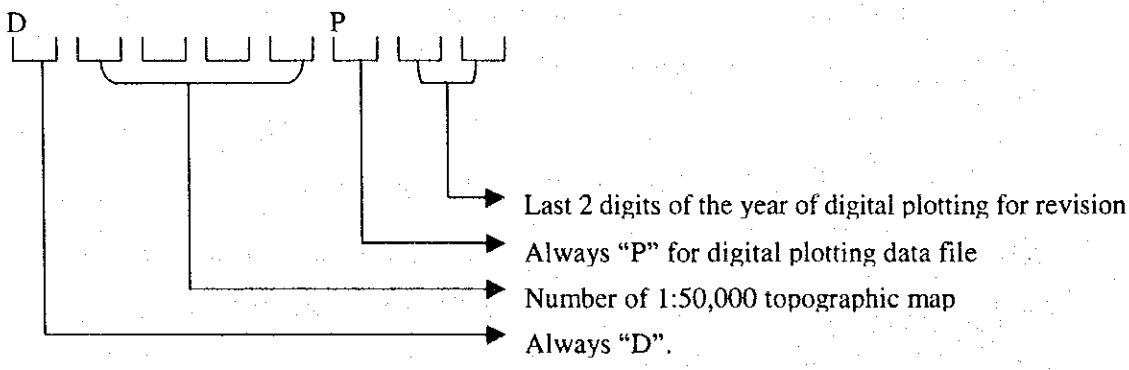
11. Archiving of Revised Digital Plotting Data

When digital plotting is completed, name the obtained data files as prescribed, make backups and archive them.

11.1 File Names

Name the files homogeneously in accordance with the scale level, based on the file naming standards for the whole country.

· For 1:50,000-scale topographic maps



Example:

D0990P99: 1:50,000-scale topographic map No. 990, digital plotting data obtained in year 1999

D1001P02: 1:50,000-scale topographic map No. 1001, digital plotting data obtained in year 2002

11.2 Backup

Store and archive the digital plotting data backup using the file names as defined in 11.1 File Names. Concerning backup operations, please refer to the manual provided separately.

12. Objectives of Digital Compilation for Revision and DM data file updating

12.1 Objectives of Digital Compilation For Revision

Digital compilation for revision comprises modifying, deleting and adding revised plotting data using a compiler, based on the results of the field identification. It also entails adjusting the old DM data so that they are compatible with the new plotting data, in order to create new compiled data.

12.2 Objectives of DM Data File Updating

DM data file updating comprises updating old DM data using revised and digitally compiled data.

12.3 How to Use This Manual

This manual has been prepared to allow smooth digital compilation operations for revision and to maintain homogeneity. Concerning how to start the compiler and its operation, please refer to the manual provided separately.

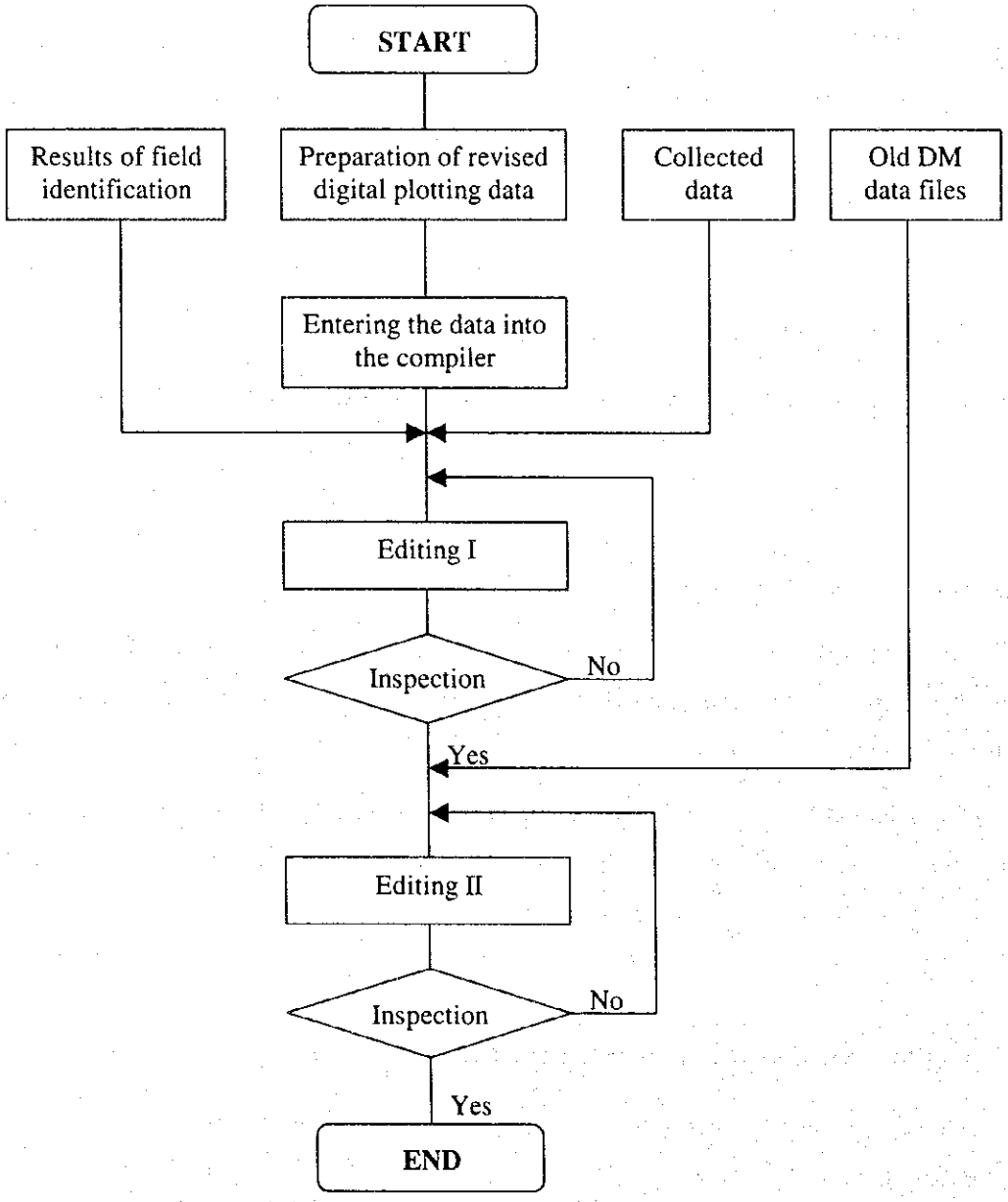
Digital compilation for revision follows the order of this manual. Refer to it in case of problem during this work. If a problem or its solution are not mentioned in this manual, the user is invited to add a memo on the subject in the appendix.

13. Outline of Digital Compilation for Revision

The features that must be represented on the map will be compiled into the revised digital plotting data previously obtained, using the results of the field identification and the collected data, in order to produce fully compiled DM data.

14. Digital Compilation for Revision

14.1 Flowchart of Digital Compilation For Revision



14.2 Entering The Data Into The Compiler

Enter the revised digital plotting data into the compiler. Concerning how to enter data into the compiler, please refer to the manual provided separately.

14.3 Editing I

Digital editing I for revision entails preparing compiled data by making additions, deletions and corrections in the revised digital plotting data, using the results of the field identification and the collected data.

14.3.1 Editing Sequence

In principle, the Editing order for features that will be added, deleted or modified is as follows:

① Control points (including spot heights)

② Linear features (rivers, channels, railways, roads, etc.)

③ Buildings (building symbols, landmark symbols, large space symbols)

④ Topography (distorted surface areas, contours)

⑤ Boundaries

⑥ Land use boundaries, vegetation symbols

Note: Editing of contour lines shall be conducted upward from the lowest contours.

14.3.2 Editing I

For a more detailed order of compilation for data additions, deletions and revisions, please refer to the manual provided separately.

14.3.3 Inspection

Print the edited data at the same scale as the topographic map being revised, and inspect the following points:

- Application of map symbols
- Representation of each item that must be represented
- Consistency with the output maps and all the collected data

14.4 Editing II

This step entails making the data compiled in 14.3 and the old DM data compatible.

14.4.1 Entering Old DM data

Enter the old DM data into the compiler, and superimpose them over the data compiled in 14.3. Concerning how to enter the old DM data and superimpose them, please refer to the manual provided separately.

14.4.2 Editing II

Make both sets of superimposed data (compiled data and old DM data) compatible, using the compiled data as the standard.

Compatibility (adjoining) means that the coordinate values must correspond. Grouped data must be revised by group units. In this case, the old data can be used directly for the parts that have not changed (copy).

14.4.3 Inspection

As in 14.3, print the obtained data at the same scale as the topographic map being revised and inspect the same points indicated in 14.3.3.

15. Updating of DM data files

The revised digital compilation data are used to update the DM data files in order to make new files containing all the secular variations.

15.1 Method to Store DM Data on Electronic Media

Store the updated DM data in DXF format on electronic media. You must check for errors in the DXF format conversion using a checking program and inspecting the data displayed on screen.

15.2 Formulation of DM Data File User's Manual

Prepare a separate DM data file user's manual.